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On the design of dielectric taper section for εr=20

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The taper section for conducting the TM01 mode from into the dielectric loaded traveling wave accelerating structure is very important. There are two X band dielectric loaded traveling wave accelerator structures we are working on. One with εr=9.4 and the other with εr=20.

At the beginning, we adopted a simple scheme for the dielectric taper section as shown in Figure 1. EM simulation results shown that it's good for the structure with er=9.4. But for the one whose εr=20, this old design doesn't work quite well. Figure 3 gives the S11 of dielectric taper section varying with the length of taper at a step of 1mm. Figure 4 gives the S11 varying with *l* in the vicinity of 34mm at a step of 0.1mm. From these two figures we see that the bandwidth is verysmall and this makes the property of taper section very sensitive to the machining errors. Figure 5 gives the S11 varying with frequency when *l*=33.8mm. This figure shows that the frequency bandwidth is also very narrow.

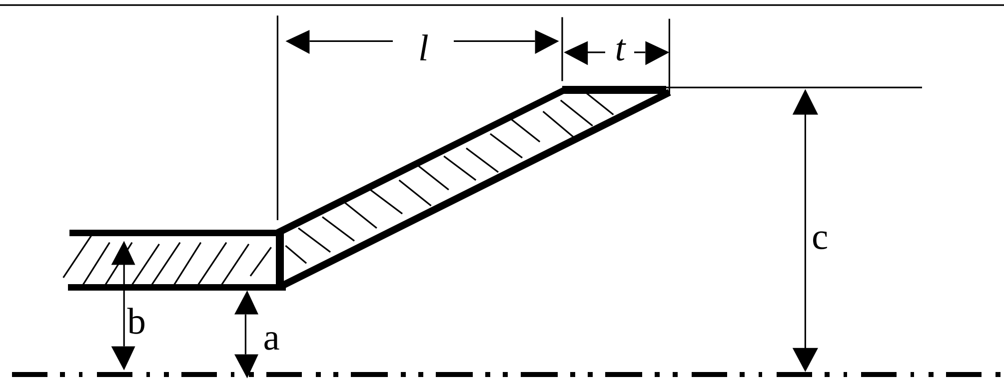

Figure 1. The old scheme of dielectric taper

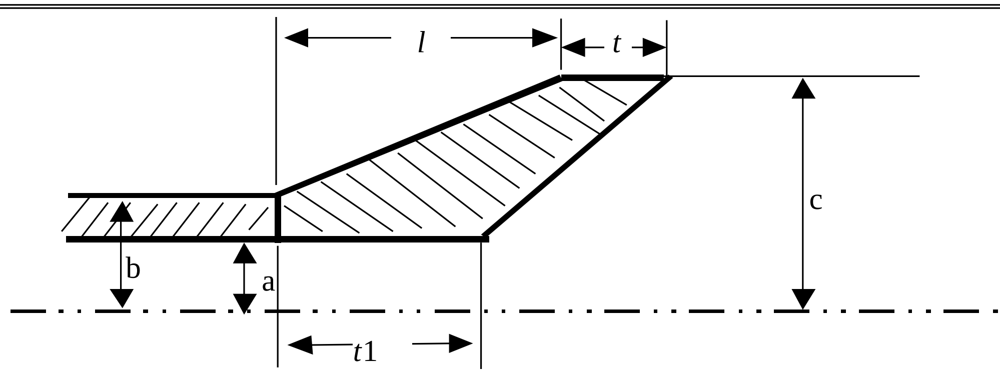

Figure 2. The new scheme of dielectric taper

To solve this problem, we proposed a new design of dielectric taper section as shown in figure 2. This new design has an advantage that we don't need to change the design of structure for hosting the dielectric taper when there is a need for us to change the dielectric taper design according to the material availability. This advantage can save us time and the cost in the developing period.

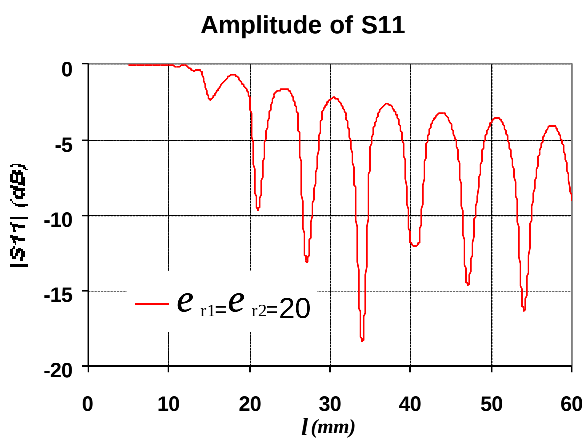

Figure 3. S11 of old taper design vary with l, the length of taper

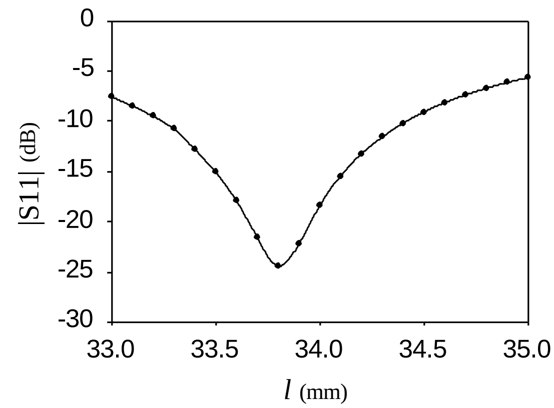

Figure 4. S11 of old taper design vary with l in the vicinity of 34mm,

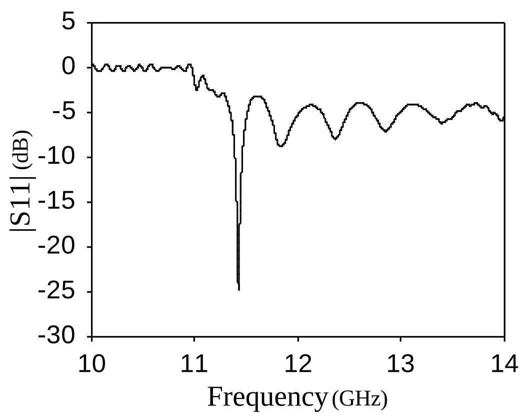

Figure 5. S11 of old taper design when l=33.8mm

As shown in the figure 2, the 3 character parameters of this design could be changed separately. This makes it more flexible than the old design. This design also makes it possible to refine its properties after the section has been made. In this report, we fixed *l*=30 and *t*=15, then optimized *t*1.

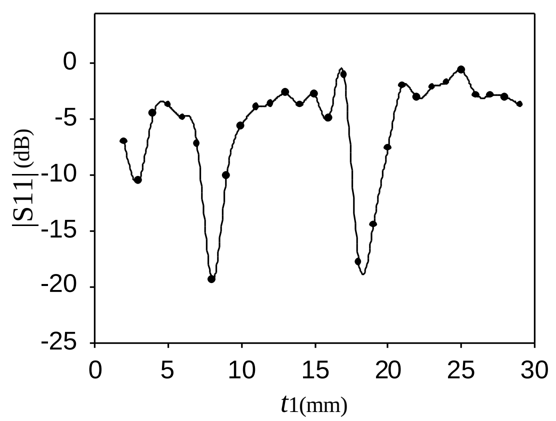

Figure 6. S11 of new taper design, varying with *t*1 from 2mm to 29 mm at a step of 1mm, the frequency is 11.424GHz

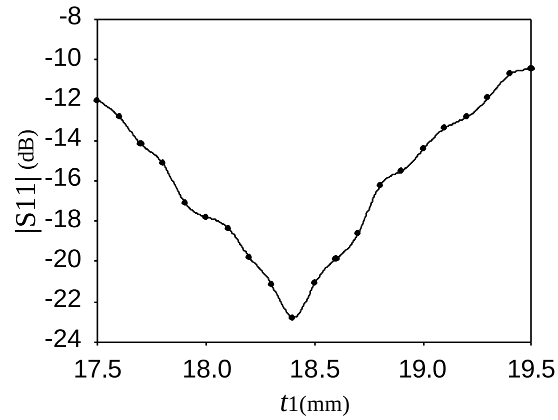

Figure 7. S11 of new taper design, varying with t1 in vicinity of 18.4mm, the frequency is 11.424 GHz

Comparing figure 4 and figure 7, we noticed that the new design has a wider bandwidth. Such wider bandwidth means that the EM property of new design is less sensitive to geometry parameter than that of the old design. This advantage makes it less critical to

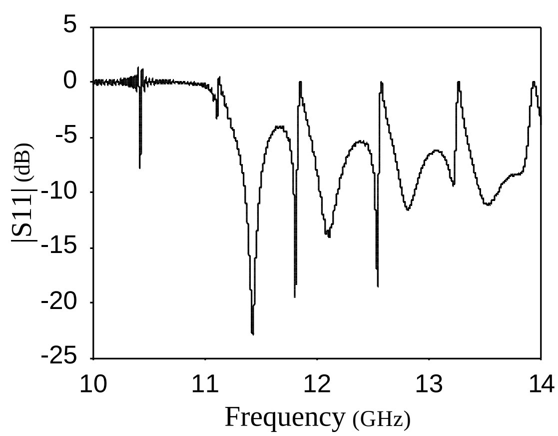

Figure 8. S11 of new taper design with *l*=30mm, *t*=15mm and *t*1=18.4mm

machining precision.

Comparing figure 5 and 8, we noticed that the bandwidth of new design is wider than old design.

As we can fix the l and t when varying t1 in the new design, we can change dielectric taper without remake the metal part hosting the dielectric taper. Such advantage can save us time and costs in the developing the accelerator.